

Littoral zone substrate composition: While walking around the lake perimeter during the VES survey (see Amphibian/Reptile Surveying, below), stop after a set number of paces (see below) and categorize the **dominant** substrate at the lake edge as one of the following: silt, sand (<2mm), gravel (2-32mm), small cobble (32-64mm), large cobble (64-256mm), boulder (>256mm), bedrock, or woody debris (pine needles and pine cones = “woody debris”).

Categorize the substrate along an imaginary transect line starting at the lake edge, extending perpendicular from shore, and lying along the first **3 meters** (10 feet) of the lake bottom. Record the number of hits for each substrate category in the appropriate field. Record a “0” for categories with no hits. Only record aquatic vegetation hits on transect with at least 10% coverage. This avoids over-representing aquatic vegetation in the lake characterization. Record this information under “Substrate transects with aquatic vegetation”. Increase the number of paces between transects when surveying large lakes and decrease the number of paces for small ponds. Shoot for fifty transects, as this is a sufficient number to provide an accurate description of the littoral zone of lakes. Lake perimeter (auto-populated in survey main for existing sites, or estimated) can be divided by 50 for number of meters between transects.

For very small sites where you can observe the entire littoral zone substrate from a single location, it is permissible to estimate the littoral substrate composition by size category visually, and then to record your estimates as percent values for each size category (make sure the total of all substrate categories equals 100%). If the lake contains large numbers of amphibians, conduct the amphibian/reptile survey first and then walk around the lake a second time to measure substrate composition.

Record the name of the person conducting the survey of lake characteristics (“Person recording habitat information”).

Littoral zone depth: At each of the littoral zone transects, also record the water depth at **one meter** from the shoreline and record in one of the following depth categories (in centimeters): 0-15, 16-30, 31-45, 46-60, >60. As with the littoral zone substrate composition for very small sites, it is permissible to estimate the water depth at one meter visually, and then to record your estimates as percent values for each size category (make sure the total of all depth categories equals 100%).

Shoreline terrestrial substrate composition: At each of the littoral zone transects, also record the dominant substrate along an imaginary line starting at the lake shore (or the top of the “bath tub ring” if the lake’s water level is below full pool) and running for **1.5 meters** (5 feet) perpendicular and away from the lake shoreline. The substrate categories are silt-64mm, 65-256mm, bedrock, grass/sedge/forbe, and woody debris. As with the littoral zone substrate composition for very small sites, it is permissible to estimate the terrestrial substrate composition by size category visually, and then to record your estimates as percent values for each size category (make sure the total of all substrate categories equals 100%). Note: brush = willows and other woody plants; forbs = non-woody plants.

Percentage Method: if you are able to stand in one spot and view the entire lake shore, substrate, etc. you may estimate the above categories using percentages of the entire lake, rather than the transect method. This can save time on small water bodies. Make sure the percentage check box is checked on your datasheet or palm and that the numbers for one category add up to 100%.

Tributary Characteristics

Each significant tributary to the water body should be surveyed for 100 meters (200m for R6 crews) for fish and amphibians. In addition general characteristics of each tributary should be recorded, see below.

Any tributary displayed on a 7.5' map should generally be surveyed and inlet or outlet information completed. Small rills should be surveyed for amphibians, but not necessarily included as a distinct tributary. Within the continuum of tributary sizes and complexities, field crews will be required to distinguish “significant” tributaries from those which do not warrant full tributary surveys. Keep in mind the primary purpose of tributary information is to assess important habitat for fish and amphibians, but not to be bogged down with intense micro-habitat analysis.

Palm – It is very important that palm users realize there is no inherent method of tracking barrier photo data to a specific tributary. Thus, ALWAYS assign a number for each tributary (i.e Inlet 2, or Outlet 1) even if there is only one tributary. It is important to make sure the same tributary number is listed on the barrier photo subform. Also, tributary numbers must be recorded on lake sketches.

Tributary GPS points: Record a GPS point where each tributary joins the lake. Also record a GPS point at the end of your tributary survey. This will help to match inlet/outlet data to the correct tributary.

Tributary number: Record number assigned for each tributary (i.e. Inlet 1, Inlet 2, or Outlet 1). This same number is to be recorded on lake sketch and included in barrier information, so that the correct barrier can be associated with the correct tributary.

Width and depth of inlets & outlets: While walking the lake perimeter, record the average width and depth at bank full of each tributary, even if dry. Inlets generally are widest at the point at which they enter the lake, so obtain the average width and depth upstream of this point. If there are no inlets, circle "no inlets". If inlet is dry enter "Dry" and continue to survey for barriers and amphibians. If there are no outlets, circle "no outlets". If outlet is dry enter "Dry" and continue to survey for barriers and amphibians.

Palm – if there are no inlets check "Inlets NOT Present". If there are no outlets check "Outlets NOT Present".

Presence of fish in inlets and outlets: Record whether there are fish present in the first 100 m (200m for R6 crews) of each inlet and outlet stream by circling "Y" or "N" for each feature. If the stream habitat in a particular inlet or outlet is such that seeing fish would be difficult and you don't see any fish, circle "?". If there are no inlets or outlets, leave this section blank. If inlets and outlets are dry, fish may be present in isolated pools and this is data that needs to be captured.

Distance to first barrier on inlets and outlets: Pace off 100 meters (200m for R6 crews) of each tributary, recording the distance from the lake to the first impassable barrier. Dry tributaries should still be surveyed. The barrier location should be recorded as the number of meters from the lake. Barriers are falls >0.75 m high if there is no pool at the base, falls >1.5 m if there is a pool at the base, or steep cascades higher than approximately 1.5 m. Logjams can float during high water, and should generally not be considered barriers. Because fish can often get over remarkable obstacles, be conservative in what you call a barrier. Provide a description of each barrier on page 2 of the data sheet (see Detailed lake and inlet/outlet description, below) or in the barrier description field in the Palm. If there are no barriers write "none". If there are no inlets or outlets, leave this section blank.

Description of fish barrier(s), UTM coordinates, photo number: Provide a GPS UTM coordinate, photo number, and a brief description of each barrier in the spaces provided. If additional space is needed, use page 2 of the data sheet (see Detailed lake and inlet/outlet description, below). Record the photo file number. It is important to read the appropriate protocols for camera setup and file naming information. Make sure your GPS is setup with the proper settings referenced in the appropriate protocol.

Spawning habitat in inlets and outlets: Up to the first barrier of each inlet and outlet or to the end of the survey reach if no barrier exists, make a visual estimate of the amount of the streambed **between the lake and the first barrier** that is suitable trout spawning habitat. The amount of spawning habitat should be recorded in terms of the number of square meters of stream bottom with the following characteristics: gravel 0.5-4 cm in diameter and not cemented into the streambed, water depths of 10-50 cm, and water velocities of 20-60 cm/s for successful spawning.

Spawning habitat data is used to estimate whether fish populations are self-sustaining. Use good calibration techniques and real measurements as necessary to assure accuracy.

Evidence of spawning in inlets and outlets: Check each inlet and outlet for evidence of spawning **between the lake and the first barrier**, if a barrier is present. This could be spawning trout, redds (nests), or newly-hatched fry (20-30 mm). Redds are often very obvious, being patches of freshly cleaned gravel 0.5-1 m in length. If you aren't sure if what you are seeing is in fact a redd, dig into the downstream portion of the disturbed gravel while holding a net downstream. If it is a redd, you should find eggs in the net after disturbing the gravel. For each inlet and outlet, circle all types of evidence that you find. If you don't find any evidence of spawning, circle "None".

Area of in-lake spawning habitat: Estimate the amount of suitable spawning habitat (using the spawning habitat criteria given above) in the lake at the mouth of each inlet and outlet. Look for the presence of spawning trout and completed redds.

Description of other in-lake spawning habitat: Restrict your description of "other in-lake spawning habitat" to areas where you observe spawning fish, redds, or large numbers of fry in areas of the lake away from inlets and outlets.

Fairy Shrimp

During the amphibian survey, be on the look out for schools of fairy shrimp. The distribution of these 2-3 cm crustaceans is poorly known for the Sierra Nevada, so we are interested in describing localities. Look for them in all bodies of water you sample. When walking around a lake, take a few minutes to also look in small pools and ponds adjacent to the lake.

If you find fairy shrimp either in your samples or during the survey of lake characteristics, indicate this on the data sheet by circling "Y" or "N" to the questions about fairy shrimp locations ("Present in lake?", "In lake-associated pools?", "Other locations?"). "Lake associated pools" are pools within 2 m of the lake. Be specific in your location descriptions, and provide a brief description of these locations (e.g., "1 m² pool 0.5 m from lakeshore on N side of lake 70675, pool is 10 cm deep"). Information on the fairy shrimp populations should include, at a minimum, location, surface area, and depth of the habitats.

Palm – If fairy shrimp are not found, be sure to check "Fairy Shrimp NOT Present". If found, uncheck box and fill out a fairy shrimp subform.

For all habitats that contain mature fairy shrimp (1.5-3 cm long, females carrying eggs) and are separated by ≥ 1 km from other fairy shrimp samples in the same drainage, collect approximately 10 adults, being sure to collect at mostly large non-egg bearing individuals (look for tusks, these are likely to be males, and males are needed to key these animals out to species). Preserve the fairy shrimp in a 20 ml vial using 95% ethanol. Make an internal label out of a page from your notebook. The label should contain the date, the Site ID, and the drainage name (in pencil). To simplify the process of determining whether a population is ≥ 1 km away from the last fairy shrimp population from which a collection was made, on the topographic map write "(F)" next to the Site ID from which fairy shrimp collections were made.

Amphibian/reptile surveying

Introduction: We will be conducting amphibian and reptile surveys at all bodies of water shown on 7.5' topographic maps, streams, and at sites not shown on the map but found during surveys and while traveling between sites.

To conduct an amphibian survey, walk **slowly** around the perimeter of the site, or along the stream, counting the number of adults, sub-adults, metamorphs, larvae, and egg masses you find of each species. Pause often to look ahead for basking animals. Use your dip net to sweep habitat and banks in an effort to spook animals. When surveying a lake, VES all inlets and outlets (see above) and lump with the lake VES data. Meadow/marsh sites should be surveyed systematically with multiple surveyors in an effort to survey the entire site. As needed, use the sterilized D-net or aquarium net to catch amphibians and reptiles for identification. Consult the field guide provided for adult and larval identification.

Record total numbers of individuals observed by species and life stage in the appropriate field. If no animals are seen during the VES, record "none" in the field. Species abbreviations are given on the data sheet. Palm- use the pick lists for species abbreviations. If no animals are seen make sure that the "Amphibians NOT Present" checkbox is checked on the amphibian header subform and do not fill out an amphibian data subform.

Under "Comments", record any interesting observations made during the survey (e.g., mountain yellow-legged frog larvae found only in shallow lagoon on NW side of lake). Also record locations of interesting observations on the map of the lake that you draw (see below). If you are surveying inlets or outlets of a lake and encounter amphibian species, record your observations on a separate line on the data sheet and note the approximate locations and species

on the inlet and/or outlet diagrams on page two. Palm – use the comment field in amphibian header to note interesting or important observations, or the numbers of animals seen in inlets/outlets, or numbers of multi-age class tads observed.

Time of day, temperature, and weather are important factors affecting the quality of any VES survey. Time your surveys to be during the warm portions of the day (roughly 9am – 6pm, however time window can vary depending upon time of year and local conditions). If the weather is too cold or stormy, VES surveys can be very inaccurate and should not be conducted.

Amphibian/reptile observers: Record the names of all people looking for herpetofauna.

Survey start time and end time: Record the time at which the survey began and ended. The start time is the time the amphibian survey began, not the time you arrived at the site. The end time is the time you finished the VES. Record time as 24 hr time.

Total survey duration: Record the total time spent searching for amphibians/reptiles. Do not include time spent surmounting lake-side obstacles (e.g., cliffs), identifying specimens, or recording notes. If two people survey the same site by walking in opposite directions around the lake perimeter, the total survey duration should include the time spent surveying by each person. This data tells how much effort went into the survey.

Weather/wind/color/turbidity: Circle the appropriate descriptor for each.

Stream survey: Using the GPS unit, record the UTM locations at the beginning and end of your stream survey.

Stream order: Stream order is a classification based on branching of streams. On a map showing all intermittent and permanent streams, the smallest unbranched tributaries are designated order 1. Where two first order streams meet, a second order stream is formed. Where two second order streams meet, a third order stream is formed (and so on...). Using your 7.5' topo map, identify which order of stream you are surveying, and record it in the box provided.

Calling?: Were any frogs calling during your survey? Circle yes or no.

Voucher specimens/tissue samples: Will be collected from populations of mountain yellow-legged frogs. Note that this is done on a population basis and not for each site. Use best judgment in determining the parameters of the population. Up to 20 disease swabs from different individuals, usually adults, will be taken at the sites that support each population.

Survey Method: Circle the method used. Note: Mountain yellow-legged frogs do not have a significant call, so aural surveys will not apply.

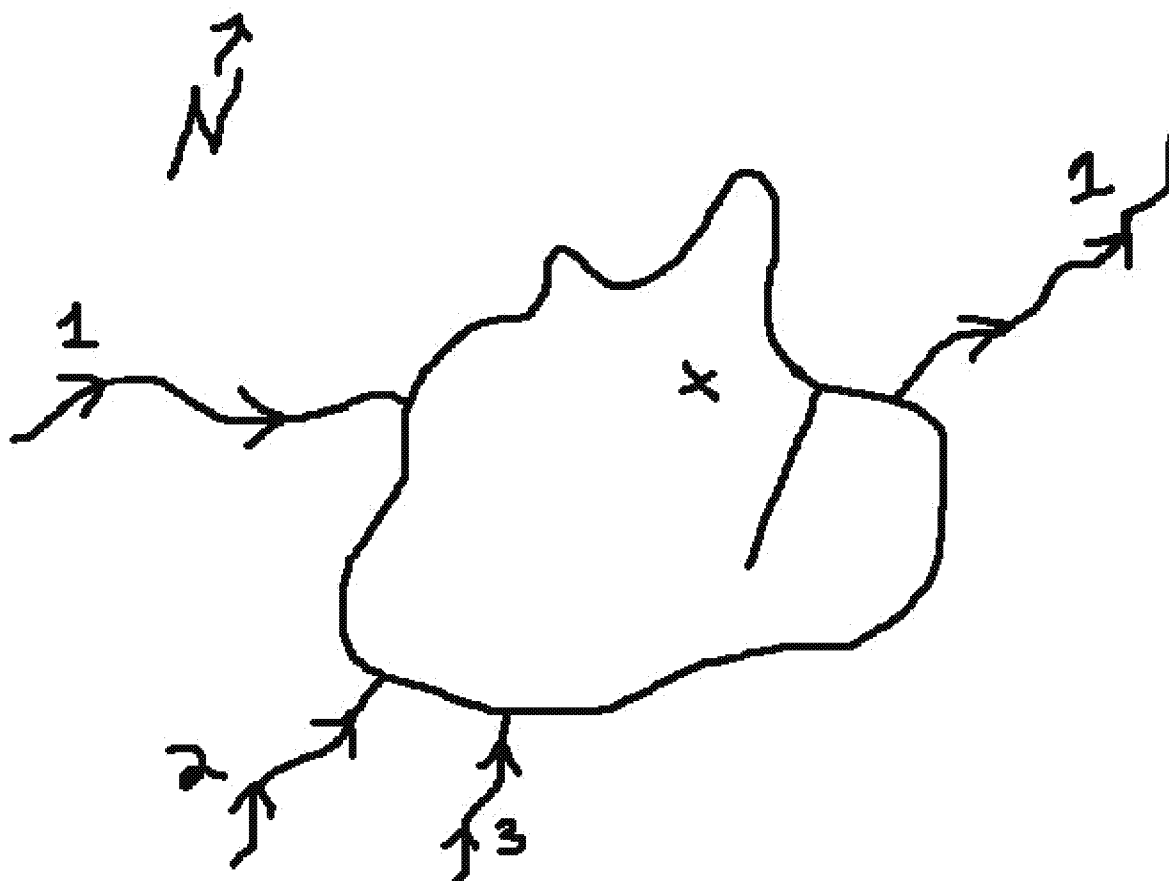
Air and Water Temperatures: Measure the air temperature from the lake shore at 1 meter above the lake surface. Measure water temperature approximately 0.5m out from shore and 10cm under the water surface. When possible, temperatures should be measured during midday (1100 – 1500). Record the time that temperatures were measured after the @ symbol and the temperature units (C or F).

Detailed Lake and Inlet/Outlet Sketches

Drawing of lake perimeter, inlets, outlets and areas of special interest: Draw the lake perimeter as best you can, use the shape on the 7.5' map if necessary. The most important information that should be included on the sketch is the inlet and outlet locations and corresponding tributary number, max depth location, net set location, North arrow (see symbology below). If there is room, note any important Mountain yellow-legged frog habitat features, such as egg mass or larvae clusters. Add a second sketch if needed. The Palms do not have a lot of room for clutter on the sketch, so keep sketches simple and not cluttered with unnecessary information such as locations of trees, boulders, small islands, good cliff jumping locations, snow fields or talus fields.

Sketch symbology: North arrow = an N with a little arrow at the top; max depth = X ; net set location = a line from the shore; Inlets and Outlets should have tributary number and can be simplified to In1 or In2 for inlets and O1

or O2 for outlets. Also include arrows <<< for directional flow (i.e. either towards or away from lake). See example below:



Description of inlets/outlets: Provide a detailed description of the physical characteristics of inlets, outlets, and barriers. For example, are inlets and outlets very steep cascades or meandering streams? How high are the barriers? Are they falls or cascades? If fish were present in inlets, were they found only below any barriers, or were they also found above the barriers? Note locations of any amphibians observed. Provide a similar description for the outlets.

Overview Photos

Introduction: All surveyed sites should have an overview photo taken. Try to find a location that allows you to capture the entire site and the habitat provided by that site. Thus a lake overview photo should capture the entire lake as well as the shoreline and any inlet or outlet marsh complexes that may be present. Use the panoramic photo functionality of the camera as needed and note how many photos were taken (Palm - in photo comments).

Often forests or flat terrain inhibit good overview photos. In these cases, do the best you can.

Photo Device: Record the device number of the camera – generally the serial number

Photo Type: Choose from the selection the reason or subject of the photo. If a panoramic photo was taken be sure to specify that in the photo type field.

Photo Numbers: Record photo file number. See Appendix for camera setup and additional file naming information.

Photo Times: The times are used to reference a photo to a particular site. It is important to record these times accurately and to ensure that both the camera and Palm date and times are properly set up.

Fish Surveying

Introduction: We will be conducting fish surveys at all bodies of water shown on 7.5' topographic maps and at sites not shown on the map but found during surveys and while traveling between sites.

Our fish survey methods are designed to provide an accurate representation of fish species composition and size structure in lakes and ponds, as well as provide an estimate of catch per unit effort (CPUE) at each location. In order to quantify the size structure of each fish species present at a particular location, we need a sample of at least 20 fish, and preferably not more than 50. Obviously, in lakes that have a very small fish population, capturing even 10 fish may not be possible.

We will set one net in each lake for 8-12 hours. Nets can be set at any time of day. To minimize logistical problems and safety hazards, do not pull nets at night. Time your net sets appropriately. For example, don't set a net at 5 PM, since this would mean either pulling the net at 1-5 AM or waiting until morning and exceeding the 12 hour maximum set duration. You should plan on setting nets in the late evening or early morning.

If you are setting a net in a lake with an extremely dense trout population (typically lakes with brook trout), you may want to paddle over the net with a float tube after 4 hours and get a rough count of the number of fish captured. If you have 40 or more fish after 4 hours, pull the net to avoid capturing an inordinate number of specimens. Use this 4 hour net set duration only when absolutely necessary. If gill-netting a lake that contains amphibians, you need not worry that the net will trap them. If turtles are present, set the gill nets during the day only and check the nets frequently to ensure that these species are not getting entangled.

Before setting a gill net, submerge the entire net (still contained on the handle); dry nets are much more susceptible to tangling. To set the net, put a small rock into each of two mesh bags and clip one bag to the shore end of the net (end with loop). Get in your float tube and wedge the bag between rocks at the lake shore and pull on it gently to ensure that it is firmly anchored. With the net lying across the float tube (lead-line on your left and net handle in your right hand or vice versa), paddle backwards slowly while feeding out the net. The net should be set perpendicular to the shore. If you encounter a tangle while feeding out the net, shake the net. Do not pull on the net as this will often tighten the tangle. Shaking will nearly always rid the net of the tangle. When you get to the end of the net, attach a float to the handle and then clip the second bag to the bottom of the net. Paddle backwards until the net is taught, and then drop the bag. Record the time when you finish setting the net.

After 8-12 hours, retrieve the net by pulling the mid-lake end of the net up by the float. Detach the float and the bag. Pull the net toward you, placing the float line on one side of the float tube and the lead line on the other. Continue pulling in the net until you reach the shore. Remove the second bag. To carry the net to an area for fish removal, cradle the net over your arms keeping the lead line on one side and the float line on the other. Lay the net down in a meadow or on a sandy flat (a meadow is preferable, but nearly any place will work; stay away from areas with lots of woody vegetation, pine needles, pine cones, and sharp rocks since they will get snagged in the net). Spread out the first 10 feet of net and remove the fish. After removing all fish from the first 10 feet of net, spread the next 10 feet of net and fold up the first 10 feet. Continue until you have removed all fish from the net. Restrung the net onto the handle, rinse the net in the lake, dry the net in the shade, tie the net in a knot to prevent tangling, and stuff it into a sack. The net may be set again without sterilization if the receiving water is located **downstream** from the previous netting site. If the next netting site is located above the previous site, or in a separate drainage (even a small side drainage within the same basin) then the net must be sterilized (see sterilization protocol).

Fish survey method: If fish are observed, generally set a net. Record whether fish were surveyed visually or using gill nets. Except for small, shallow (<2 m) bodies of water in which the surveyor can see the entire lake bottom, we typically sample fish populations using gill nets. If there is any question as to whether fish are present in a lake, set a net. The only other exception is lakes/ponds where populations of yellow-legged frogs are present. The decision whether to set a gill net in a shallow pond is up to the crew leader, but keep in mind that fish can live in some very marginal habitats. If only a visual fish survey is needed (e.g., because the lake is < 2 m deep and you can see the entire bottom and there is positively no fish, or because there is a healthy population of frogs), you need not fill out the third and fourth pages of the datasheet. (For Palms this is the "Fish Subform.")

Visual Survey Justification: If you surveyed for fishes visually, provide a brief justification as to why you chose this method (e.g., "pond only 50 cm deep, entire bottom visible, no fish seen or frog population present"). Remember, if fish are seen you should almost always set a net.

Net set time and date: Record the time when you completed the net setting process, not the time when you started setting the net. Record the time as 24 hr time. Record the date on which the net was set.

Net pull time and date: Record the time when you began pulling the net. Record the date on which the net was pulled.

Site ID: If you are setting a gill net to survey a fish population, fill out pages 3 and 4 of the datasheet. First, record the Site ID again. This identifier will ensure that both sheets of the datasheet are associated with the correct lake. Make sure that the Site ID you record is the correct one and matches the Site ID on the first page of the datasheet.

Water temperature: Measure water temperature approximately 0.5 m out from shore and 10 cm under the water surface. Record temperature in Celsius. Temperature should be measured during midday (1100-1500) when possible.

Description of net location/setting nets: Circle the appropriate location and provide a brief description of the area in which the net was set ("Comments"). Gill nets should always be set at the lake outlet, if present and if conditions allow. If an outlet does not exist, or is located in an area that is difficult to net (water <2 m deep, log jams, etc.), set nets at the inlet. If an inlet is not present or is not suitable, set the net in a suitable location anywhere along the lake shore. If possible, choose an area that is 3-8 m deep.

Fish Data: If no fish were captured, write "no fish" across the fish portion of the data sheet. If fish were captured, record the species, length, and weight of all fish. Species abbreviations are given at the bottom of the data sheet. Measure fish using the vinyl tape laid out on the ground. Measure fish total lengths to the nearest mm. Weigh fish using a Pescola spring scale. Before weighing fish, ensure that all debris (small rocks, etc.) are removed from the fish. Use the 60g scale for all fish <100 g, and the 300g scale for larger fish. Outliers may need to be weighed in parts.

All fish will need to be cut open to determine sex. If someone on your crew is able, also note the general contents of fish stomachs (e.g., chironomid pupae, terrestrial insects, etc.). If you encounter a lake that contains both fish and amphibians, look through the fish stomachs very carefully for amphibian remains.

Female fish will have eggs ranging from very small (early) to large and flaccid (late, deflated looking). Make a check mark in the appropriate box for each female fish sampled.

Fish age-analysis can be used to determine if a population that has been supported by biennial (or less frequent) stocking is self-sustaining. Otoliths (ear-bones) should be collected from up to twenty of the sampled fish over the range of sizes captured that are less than 200 mm total length, and **only** from lakes where it is difficult to determine whether fish are self-sustaining (young-of-the-year are not visibly present in tributaries or around margins of lake). Do not collect otoliths from brook trout, since the Department no longer stocks them in most waters. Place otoliths from each fish into a separate vial labeled with the Fish #. Label the vial with a fine-tip Sharpie. Keep all vials for a particular lake's otolith sample in a small Ziplock bag with an internal paper label that includes the date, the Site ID, the drainage, and the species of fish.

Be careful about disposing of fish carcasses, as we don't want the carcasses attracting the attention of backpackers or bears. The best disposal method is to pop the fish's swim-bladders, paddle out into the lake until you reach a relatively deep area, and dump them. Burial of fish on land should generally be avoided, as animals can smell the fish and will dig them up (no matter how deep you bury them).

Net sterilization: When moving to a different drainage or when one site does NOT flow into the next site gear (float tube, waders, fins and gill nets) must be sterilized. Sterilize using 5 ml of Quat 128 per 1.5 gallons of water. Gear must be soaked for at least 20 minutes and dried for at least 20 minutes. Dispose of Quat 128 on rocks or soil away from waterways. Consider rinsing gear in fresh water away from potential amphibian sites before next use.

Field review of datasheets

At the end of each day, the crew leader should review all datasheets for completeness and clarity. Once review of a datasheet is completed, the crew leader should initialize the field review box on pages 2 and 3 of the datasheets. Make sure all of the spaces on the data sheets have been filled in. These data sheets are all the state has to show for the time and money that went into each survey. Protect the data sheets as if they were your most prized possession!